Comparison of non contrast-enhanced balanced TFE and CE-MRA for Evaluation of Upper Extremity Vasculature Prior to Vascular Access Creation

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Introduction
Pre-operative mapping of upper extremity vascular anatomy is highly desirable in patients with end-stage renal disease (ESRD) scheduled to undergo dialysis access creation. Precise knowledge of arterial and venous anatomy helps to prevent short- and long-term post-operative complications by enabling selection of the most suitable site for vascular access creation. Unfortunately the current standard of reference for non-invasive vascular imaging – contrast-enhanced (CE) MRA – has been linked to nephrogenic systemic fibrosis (NSF) in patients with ESRD. Recently developed non contrast-enhanced (NCE) MRA techniques might offer an attractive alternative in these patients. However, little is present about the feasibility and image quality of NCE MRA for evaluation of the upper extremity vasculature.

Purpose
The purpose of this work was to evaluate a NCE balanced turbo field echo (bTFE) MRA protocol for the assessment of upper extremity vasculature prior to dialysis access creation and to validate this protocol in comparison to the current standard of reference for vascular imaging, CE-MRA using a macrocyclic gadolinium chelate.

Materials and Methods
All MR acquisitions were performed with a commercially available 1.5T MR scanner (Gyrospec Intera, R11.0, Philips Medical Systems, Best, The Netherlands) using multi-element phased-array surface receive coils to cover the entire upper extremity and central part of the chest. The bTFE imaging protocol was a modified version of the sequence as described Gjesdal et al. First, the imaging protocol was optimized mainly by varying the size of the FOV to minimize black banding artifacts at the edges of the FOV associated with the bTFE sequence. Other imaging parameters were: TR (ms) / TE (ms) / FA (°) / Acquisition duration: 11 / 5.6 / 80 / 4m19s. To cover the entire upper extremity from the palmar arch to the heart three scans were acquired, making the total acquisition duration of approximately 12m30s. Acquired voxel size was 1.56 x 0.78 x 0.78 mm³. The CE-MRA acquisition comprised two separate injections of 10 mL 1:1 diluted macrocyclic contrast medium (Gadovist, Bayer Schering Pharma, Berlin, Germany). Each acquisition consisted of 4 dynamic scans. Imaging parameters were: TR (ms) / TE (ms) / FA (°) / Acquisition duration: 5.4 / 1.6 / 40 / 45s. Acquired voxel size was 0.75 x 1.38 x 1.68 mm³. We acquired bTFE and CE-MRA datasets in ten healthy volunteers. Subsequently, five patients with CKD 4-5 were enrolled to prove the feasibility in the diseased population. All datasets were reviewed in a blinded fashion by a radiologist with >5 years experience in vascular MR imaging. For analysis purposes the upper extremity vascular tree was divided in 11 arterial and 16 venous segments. The institutional ethics committee approved the study protocol and written informed consent was obtained from all participants.

Discussion and Conclusions
Depiction of arterial and venous structures in the upper extremity is feasible using a NCE-bTFE technique. Arterial image quality and image contrast of CE-MRA remain superior to NCE-bTFE. However, bTFE imaging yields images that are of diagnostic quality in the vast majority of subjects. With NCE-bTFE on the other hand it was possible to visualize significantly more venous segments with comparable or superior image quality compared to CE-MRA. In conclusion, NCE-bTFE is an attractive alternative for CE-MRA in patients with ESRD who need to undergo imaging to determine the optimal site for access creation.

Acknowledgement
This work was carried out in the context of the ARCH project (ICT-22439) funded by the European Union 7th Framework Programme.

References
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